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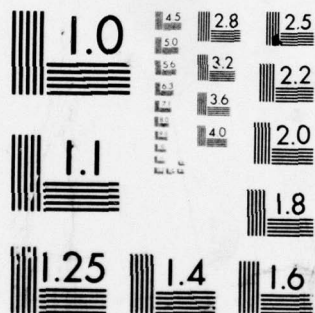


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DENTAL PULP REACTION TO CAVIT
TEMPORARY FILLING MATERIAL

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ABSTRACT

Seventy-two teeth were utilized on three Macaque fascicularis monkeys to evaluate pulpal response to Cavit. Odontoblastic nuclei displacement was histologically evaluated at three time periods to identify initial, early and final response. There were no statistically significant differences in pulpal response between Cavit and the zinc oxide-eugenol controls when utilized in accordance with the manufacturers directions.

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Interim filling materials have gained wide acceptance as therapeutic agents, insulating bases, and as temporary restorative materials. Although Cavit has been utilized in these capacities, a review of the literature has revealed few studies evaluating the pulpal response produced by Cavit.

Previous studies evaluating the physical properties of Cavit have reported that no aspiration of odontoblastic nuclei was observed when Cavit was utilized in accordance with the manufacturer's directions. It did occur, however, with desiccation.¹

The use of zinc oxide-eugenol as a control material provides a method of differentiating between the pulpal effects caused by cavity preparation and those caused by the restorative material. Of all the filling materials, zinc oxide-eugenol is the safest from a biologic standpoint.²

The purpose of this study is to evaluate Cavit as an interim filling material by comparing its pulpal effects with those of zinc oxide-eugenol in the dental pulp of Macaque fascicularis monkeys.

Materials and Methods

Three young adult Macaque fascicularis monkeys, weighing between 4.5 and 6.8 kilograms, were used in this study.

Operative procedures were performed while the monkeys were sedated with Sernylan.* Sedation was obtained with 0.7 to 0.9 cc Sernylan (20 mg per cc) injected IM. Nine teeth were randomly selected to serve as controls and fifteen teeth served to test Cavit in each treatment phase. Each monkey was represented in each time frame. The ADA method of testing dental pulp response was employed in an attempt to minimize all experimental variables.³

Class V cavities were prepared using high speed rotary instruments. A new #35 carbide bur was utilized for each procedure. Water-spray provided a coolant at the bur-tooth interface. An attempt was made to obtain consistent cavity

* Sernylan (Phencyclidine HCl), Bio-Centic Laboratories, St. Joseph, Mo. 64502

preparations. The cavity preparation was irrigated with normal saline and dried with cotton pellets. Care was taken not to desiccate the cavity preparations. A total of twenty-four teeth were prepared at each time interval. The control teeth were restored with zinc oxide-eugenol to permit evaluation of the degree of trauma caused by the operative procedure. The teeth receiving the test material were restored with Cavit utilized in accordance with the recommendations of the manufacturer.

Pulpal responses were evaluated histologically at 48 hours for initial reaction. A second evaluation at 27 days were designed to provide information on the progression of the acute phase. A third evaluation at 51 days assessed the extent of the final resolution.

The presence of odontoblastic nuclei in the dentinal tubules is considered a good indicator of pulpal reaction,⁵ and this observation was utilized to measure pulpal response. The extent of odontoblastic nuclei displacement was graded (1) minimal, (2) mild, (3) moderate, or (4) severe. Minimal displacement was related to movement by the odontoblast nuclei toward or into the predentin zone, while mild displacement represented actual movement into the dentin (Fig. 1). Moderate displacement was considered to have occurred when a significant number of nuclei were seen to have advanced at least half way toward the base of the cavity preparation (Fig. 2); and severe displacement represented a substantial number of nuclei having reached the cavity preparation (Fig. 3).

The monkeys were sacrificed by injection of 0.2 cc Pentobarbital* intracardiac while under sedation. Surgical removal of the maxilla and mandible was accomplished by disarticulation and block sectioning to provide exposure of the apical one third of the anatomical tooth root. The block sections were immediately placed in 10% formalin for a minimum of 48 hours. The teeth were removed as atraumatically as possible by removal of buccal bone, and elevation of the tooth

* Sodium Pentobarbital, Pitman-Moore, Washington Crossing, N.J.

from the alveolus. The specimens were decalcified and trimmed of excess dentin when the teeth were flexible. The teeth were embedded in paraffin; sectioned at 6 microns, and stained with hematoxylin and eosin.⁴ The specimens were coded to assure blind histological evaluation of the pulpal response.

Results

Teeth which were examined 48 hours after treatment provided a method of assessing the initial response to the cutting and restorative procedures. Nine teeth were examined in the control group, and fifteen teeth in the Cavit test group. Those specimens restored with zinc oxide-eugenol had an average intensity value of odontoblast nuclei displacement of 1.9, while those restored with Cavit had an average intensity value of 2.2. The data were analyzed using the chi-squared technique. The result of the analysis was not statistically significant ($\chi^2=2.23$, $df=1$, $p=n.s.$), indicating no difference between the control and test materials in the initial phase of pulpal response. The shortest distance from the base of the cavity preparation to the pulp measured along the dentinal tubules ranged from 0.9 to 1.5 mm in the control group, with a mean remaining dentin value of 1.1 mm. This distance ranged from 0.6 to 1.3 mm in the Cavit specimens, with a mean value of 1.0 mm.

At 27 days nine teeth were examined in the control group and fifteen in the test group. Those specimens restored with zinc oxide-eugenol revealed an average intensity value for odontoblastic displacement of 1.5, while the test Cavit value was 2.0. Chi-squared analysis resulted in a non-significant χ^2 ($\chi^2=0.02$, $df=1$, $p=n.s.$), thus indicating no significant statistical difference in the severity of the delayed response to either material. The mean remaining dentin thickness for the control specimens was 1.1 mm, with a range from 0.9 to 1.2 mm. Mean remaining dentin in the Cavit test group was 1.0 mm, with a range from 0.8 to 1.4 mm.

At 51 days, a time interval chosen to represent final resolution of pulpal reaction, nine control specimens presented an average intensity value for

odontoblastic nuclei displacement of 1.9. Fifteen Cavit test specimens resulted in an average value of 1.4. Again the results of a chi-squared analysis was not statistically significant ($\chi^2=0.23$, $df=1$, $p=n.s$) indicating that no difference existed between control and experimental groups. Control specimens had a range of remaining dentin from 1.0 to 1.4 mm, with a mean of 1.1 mm. The mean remaining dentin in the Cavit test specimens was 1.0 mm, with a range from 0.8 to 1.3 mm.

Discussion

The traumatic injury inflicted upon pulpal tissues is considered to be minimal and reversible with close attention to biologically acceptable procedures.^{6,7} All precautions were taken during cavity preparation and treatment in the present study to insure that the reactions observed by odontoblastic nuclei displacement would originate from the effect caused by the filling materials utilized.

Langeland has stated that the finding of odontoblast nuclei in the dentinal tubules constitutes the only valid evidence for injury to these cells,⁶ and is a valid indication of a pathologic reaction having taken place within the pulp.⁸ This then can be utilized as a gauge of injury experienced by the pulpal tissues, and is considered to be the only certain histologic criterion for evaluation of the degree of injury.^{5,9} Displaced odontoblasts in this study were found confined to the cut dentinal tubules associated with the restorative materials, and were employed as a measure of pulpal involvement.

Swerdlow and Stanley have shown that in cavity preparation procedures the remaining dentin thickness is the most significant factor in determining the degree of pulpal response when the cavity is restored with a relatively inert material.¹⁰ When the time interval and remaining dentin thickness is known, Stanley has stated that most other problems of interpretation due to biologic variation can be extrapolated.⁷ A direct relationship is felt to exist in clinical specimens between the cavity depth and the degree of pulpal reactions.

Sayegh and Reed have recommended that the depth of remaining dentin in monkey teeth as measured along the shortest distance from material to pulp be not more than 1.0 mm.¹¹ In this experiment the average remaining dentin in all time frames for zinc oxide-eugenol was 1.1 mm, while for Cavit it was 1.0 mm.

The application of dehydrating agents has been shown to remove enough water to give rise to an outward movement of dentinal tubular contents.^{5,12} This reduced pressure in the cavity preparation could result in the displacement of the odontoblast nuclei into the tubules beneath the cavity.^{1,5,13}

Cavit and zinc oxide-eugenol are similar in that they both set hydroscopically.^{1,14} They differ, however, in their need for continued water. Cavit sets only after permeation with water, the final set product resulting from a reaction with calcium sulfate and zinc oxide-zinc sulfate. Zinc oxide-eugenol undergoes an autocatalytic reaction which is initiated by water. A by-product of this initial reaction is water, which then allows continuation of the setting reaction without the need of additional outside water.¹ Since both Cavit and zinc oxide-eugenol exhibit hygroscopic capability, which could result in odontoblastic nuclei displacement, it seems logical that this might serve as a means of comparison. Although Cavit has a six-fold greater absorption value than zinc oxide-eugenol,¹ no statistical difference in displacement was found by analysis in any time frame. This would indicate that Cavit does not initiate greater pulpal response than does zinc oxide-eugenol.

Conclusions

When utilized in accordance with the manufacturers directions, Cavit may serve as a biologically acceptable interim filling material. Results obtained in this study indicate no statistically significant difference between Cavit and zinc oxide-eugenol.

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In conducting the research described in this manuscript, the investigators adhered to the "Guide for The Care and Use of Laboratory Animals," as promulgated by the Committee on The Guide for Laboratory Animal Facilities and Care of the Institute of Laboratory Animal Resources, National Academy of Sciences - National Research Council.

LEGENDS

- Figure 1 Photomicrograph showing mild odontoblastic displacement into the predentin and dentin. Control specimen 27 days. Magnification x 400.
- Figure 2 Moderate displacement of odontoblastic nuclei into dentin (N→). Edema and disorganization in the odontoblastic layer is evident. Dilation of vascular channels in pulp. Control specimen 48 hours. Magnification x 64.
- Figure 3 Photomicrograph with severe displacement of odontoblastic nuclei. Cavity (C). Cavity Tubules (T). Experimental specimen at 48 hrs. Magnification x 64.